

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

A 281.9
Ag 8
copy 2

LARGE-SCALE SHIPPING TECHNIQUES FOR TOBACCO BUDWORM PUPAE

Production Research Report No. 166

JUN 7 '75

PROCUREMENT SECTION
CURRENT SERIAL RECORD

U.S. DEPT. OF AGRICULTURE
NAT'L AGRI. LIBRARY
RECEIVED

EXTRA COPY

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE
in cooperation with
Texas Agricultural Experiment Station

CONTENTS

	Page
Abstract	1
Introduction	1
Methods and materials	1
Laboratory studies	1
Shipping tests	2
Results and discussion	3
Laboratory studies	3
Shipping tests	5

ILLUSTRATION

Fig.

- | | |
|---|---|
| 1. Disposable container for shipping tobacco budworm pupae .. | 3 |
|---|---|

TABLES

- | | |
|--|---|
| 1. Temperatures in two types of insulated containers used for shipping tobacco budworm pupae | 4 |
| 2. Emergence of tobacco budworm pupae held 65 hours in Styrofoam biomailer with no coolant and in Styrofoam ice chest with coolant | 4 |
| 3. Average temperatures of tobacco budworm pupae in 1-pint cartons held in perforated cardboard box | 5 |
| 4. Emergence of tobacco budworm pupae held for 60 hours in perforated cardboard shipping containers; 500 pupae observed | 5 |
| 5. Emergence of tobacco budworm pupae shipped in Styrofoam ice chests from Brownsville, Tex., to St. Croix, V.I. | 6 |
| 6. Pupal eclosion following shipment to St. Croix in 1-pint cartons placed in perforated cardboard boxes | 6 |

LARGE-SCALE SHIPPING TECHNIQUES FOR TOBACCO BUDWORM PUPAE

By J. R. RAULSTON, J. W. SNOW, and H. M. GRAHAM, *entomologists, Cotton Insects Research Laboratory, Brownsville, Tex., and PAUL JAMES, agricultural engineer, Agricultural Environmental Quality Institute, Beltsville, Md.*

ABSTRACT

Methods were evaluated for shipping large numbers of *Heliothis virescens* (F.) pupae via airmail to St. Croix, V. I., from Brownsville, Tex. Laboratory tests indicated that adequate ventilation or cooling was necessary to allow dissipation of metabolic heat produced by the pupae during shipment. The shipping method developed utilizes a well-ventilated shipping container that can be disposed of after one use.

INTRODUCTION

In recent years methods have been developed for large-scale rearing of the tobacco budworm, *Heliothis virescens* (F.).¹ The effective use of these insects, however, requires that they be shipped over varying distances, and the shipping itself has been found to pose certain dangers to the insect pupae.

Snow et al.² determined one of the major problems associated with shipping pupae of the corn earworm, *Heliothis zea* (Boddie), to be temperature increases within the shipping containers as a result of metabolic heat. They observed 100 percent mortality in corn earworm pupae sent from Tifton, Ga.,

to St. Croix, V. I., when metabolic heat was not allowed to dissipate. Among other problems, they also encountered physical damage acquired during shipment.

Thus, when confronted with the task of shipping as many as 65,000 tobacco budworm pupae per day from the Cotton Insects Research Laboratory, Brownsville, Tex., to St. Croix for a sterile-release program there, we initiated the development of techniques for shipping tobacco budworm pupae that would adequately dissipate heat and minimize physical damage.

METHODS AND MATERIALS Laboratory Studies

The two basic types of shipping containers tested were (1) Styrofoam-insulated ice chests and bio-mailers and (2) noninsulated, perforated, corrugated cardboard boxes. The temperature increase caused by metabolic heat was determined by measuring tempera-

¹ Raulston, J. R., and Lingren, P. D. 1972. Methods for large-scale rearing of the tobacco budworm. U.S. Dep. Agric. Prod. Res. Rep. No. 145, 10 pp.

² Snow, J. W., Jones, R. L., Sparks, A. N., and others. 1971. Shipment of corn earworm pupae through the U.S. postal system. U.S. Dep. Agric. Prod. Res. Rep. No. 138, 5 pp.

ture in both the noninsulated and insulated containers with and without coolant. The containers were held in the laboratory at 27° C. Pupae used in these tests were reared by the method of Raulston and Lingren³ and were harvested on the 21st day after egg implantation. Such pupae are within 3 to 4 days of adult eclosion.

In an initial test, temperatures were recorded in a Styrofoam-insulated biomailer (19 by 27 by 27 cm) and in a Styrofoam ice chest (53 by 33 by 23 cm), both containing pupae. The biomailer contained 5,000 tobacco budworm pupae mixed with moist vermiculite and layered between sheets of 1/2-inch-thick polyurethane foam. Thermocouples were placed in the lower, middle, and upper sections of the biomailer. The ice chest contained two 1-quart cans of Blue Ice coolant and six 1/2-gallon ice cream cartons, each containing 1,000 pupae in moist vermiculite. Thermocouples were placed directly into the cartons containing pupae.

To study the use of disposable shipping containers, pupae were again mixed in moist vermiculite and placed in 1-pint cartons (about 160 per carton) which were in turn placed in a perforated cardboard box (21 by 25 by 40 cm), as illustrated in figure 1. Each box contained 24 1-pint cartons. Temperatures were measured inside the cartons containing pupae, and the packing units were held at 21.5° or 27.1° C ambient temperature.

We also investigated the use of sealed polyethylene bags containing pupae as described by Tanaka et al.⁴ for shipping the melon fly, *Dacus cucurbitae* Coquillett. In our test, 500 pupae were placed in each of two polyethylene bags, then, prior to sealing, sufficient air was withdrawn to just collapse the bag on the pupae. The bagged pupae and 500 check pupae were held at 28.9° C for 48 hours, after which time the pupae were removed from the bags and emergence records taken.

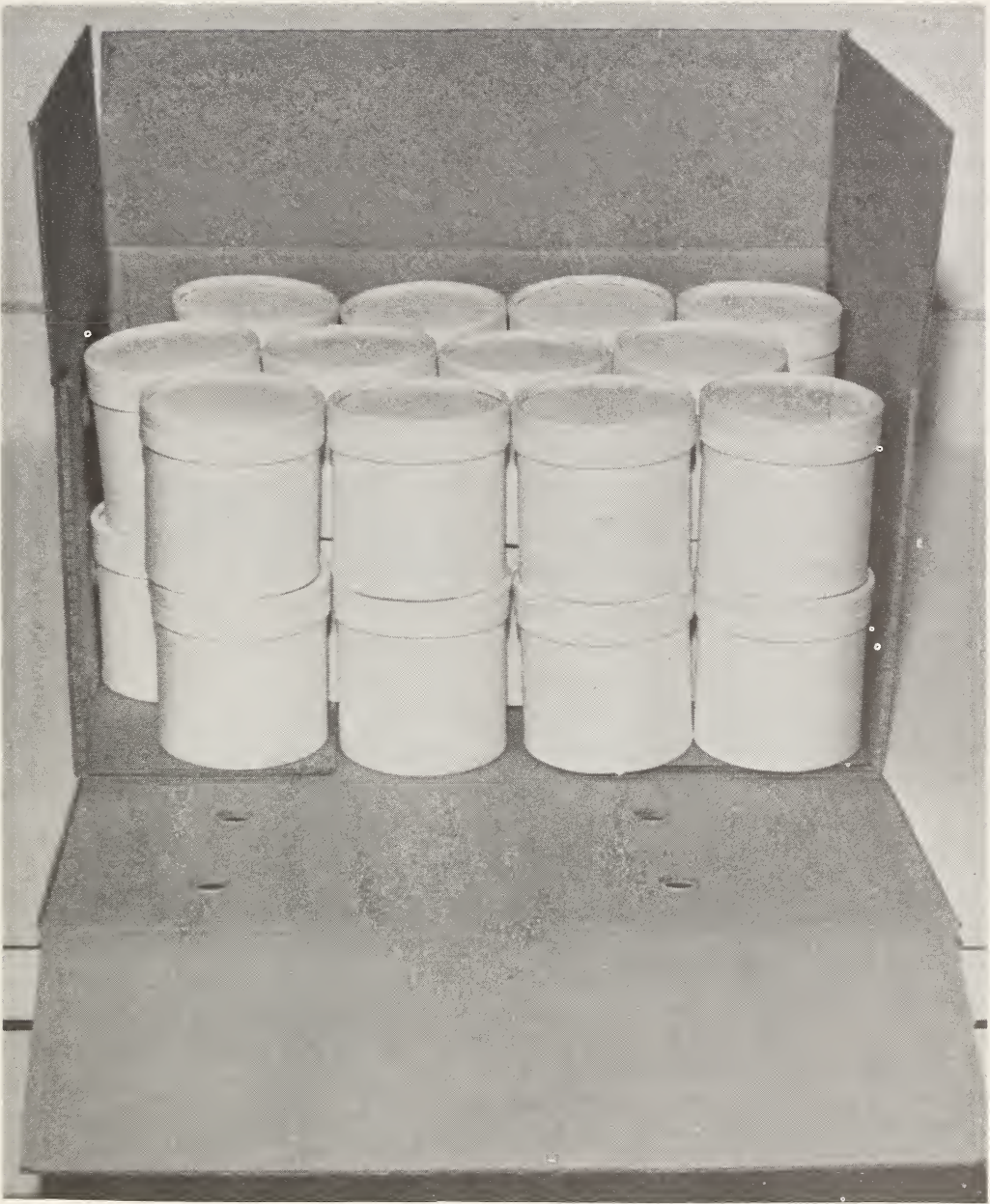
Shipping Tests

Pupae were shipped by airmail to St. Croix in the insulated and noninsulated containers. Upon receipt at St. Croix, 200 to 500 pupae were removed for tabulation of survival. Emerging adults were tabulated as sound or crimp-winged, and these data were compared with similar quantities of control pupae held at Brownsville, Tex. Initial experimental shipments were in transit for up to 75 hours; however, shipments following initiation of the release program normally required only 24 to 48 hours.

Six experimental shipments were made to St. Croix with the Styrofoam ice chests. Pupae were mixed in moist vermiculite and placed in 1-pint cartons (160 per carton). For each shipment, 28 of the 1-pint cartons, along with 4 cans of coolant, were placed in the coolers. All excess space was

³ Cited in footnote 1.

⁴ Tanaka, N., Ohinata, K., Chambers, D. L., and others. 1972. Transporting pupae of the melon fly in polyethylene bags. *J. Econ. Entomol.* 65: 1727-1730.



PN-4535

FIGURE 1.—Disposable container for shipping tobacco budworm pupae.

filled with polystyrene packing material to reduce movement within the packing unit. The 1-pint cartons were used in this test since in the laboratory we had noted excessive settling of the pupae and vermiculite mixture in the larger containers.

Large-scale shipments using the

corrugated box system described in the previous section were carried out, and data were collected on the effectiveness of this system.

RESULTS AND DISCUSSION Laboratory Studies

Heat buildup within the bio-mailer with no cooling source was

rapid, and within 24 hours reached an asymptote of about 34° C (table 1). This temperature remained constant for the duration of the test. Temperature recordings from the ice chest containing coolant showed an initial decrease during the first 16 hours, followed by a gradual increase, though temperatures never exceeded 28.6° C during the duration of the test. The emergence data in table 2 illustrate the effects of the treatments. Use of the ice chest with coolant resulted in an 8-percent reduction in normal emergence, while the uncooled biomailer resulted in about 90-percent reduction as compared to the control. High temperature within the biomailer probably does not account for all the reduction in emergence, since Guerra⁵ observed only a 14.5-percent reduction in emergence in pupae exposed continuously to 32.3° C. Anoxia caused by increased metabolic rate may also have played some part in the decrease in normal emergence, a

⁵ Guerra, A. A. 1972. Induction of sexual sterility in bollworms and tobacco budworms by heat treatment of pupae. J. Econ. Entomol. 65: 368-370.

TABLE 1.—*Temperatures in two types of insulated containers used for shipping tobacco budworm pupae*

Hours	Average temperature (° C) ¹	
	In biomailer	In ice chest
0	28.3	24.7
16	31.7	17.2
24	33.9	23.6
48	33.0	28.6
65	34.4	27.5

¹ Biomailer had no cooling source; ice chest had 2 1-quart containers of Blue Ice for cooling. Shipping containers were held at an ambient temperature of about 25° C.

conclusion further substantiated when pupae were placed in sealed polyethylene bags. Eclosion from control pupae resulted in 76.4-percent sound adults, while of pupae placed in bags, only 26.4 percent emerged as sound adults.

When pupae were packed in the perforated corrugated boxes, temperatures within the 1-pint cartons containing pupae closely paralleled the ambient temperature under both temperature regimes, indicating that dissipation of metabolic heat from this system was

TABLE 2.—*Emergence of tobacco budworm pupae held 65 hours in Styrofoam biomailer with no coolant and in Styrofoam ice chest with coolant*

Treatment	Pupae		Adults	
	Observed (No.)	Dead (%)	Normal (%)	Malformed (%)
Control ¹	400	6.5	88.3	5.2
Biomailer	1,162	44.1	8.8	49.1
Ice chest	1,065	13.6	80.4	6.0

¹ Control pupae were mixed in moist vermiculite and held at 28.9° C.

adequate to maintain internal temperatures close to ambient (table 3). Data listed in table 4 also show that emergence of sound adults from pupae held for 60 hours in packing boxes closely parallels emergence from control pupae. Thus, based on internal temperatures and adult eclosion, we concluded that this packing system had no detrimental effects on the insect at temperatures between 21° and 31° C.

Shipping Tests

Shipment of moth pupae in cooled ice chests resulted in a 24.5-percent reduction in normal moth

emergence as compared to emergence among similar pupae which were not shipped (table 5). The greatest part of this reduction was attributable to the large number of crimp-winged adults, since there was only a 6-percent difference in the number of dead pupae. The two major disadvantages noted in making shipments with the ice chests were that (1) their cost necessitated their return to the rearing point for reuse and (2) damage in shipment rendered the coolers unusable after one or two trips. Later shipments with bio-mailers indicated that these con-

TABLE 3.—Average temperatures of tobacco budworm pupae in 1-pint cartons held in perforated cardboard box

Time (hours)	Temperature (° C)					
	Ambient		Inside carton		Outside carton but in packing box	
	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2
0	21.1	19.4	21.1	18.6	21.1	19.0
24	22.2	28.9	21.1	27.5	21.1	28.7
36	21.1	31.1	21.1	30.3	21.1	30.9
60	21.7	28.9	21.1	27.8	21.1	28.3

TABLE 4.—Emergence of tobacco budworm pupae held for 60 hours in perforated cardboard shipping containers; 500 pupae observed

Treatment	Emerging as adults (%)		Dead pupae (%)
	Sound	Malformed	
Control:			
Test 1	81.4	4.2	18.6
Test 2	92.8	4.4	7.2
Pupae held in cardboard box:			
Test 1	79.2	6.8	20.8
Test 2	94.6	3.8	5.4

TABLE 5.—*Emergence of tobacco budworm pupae shipped in Styrofoam ice chests from Brownsville, Tex., to St. Croix, V.I.*

Treatment	Pupae sampled (No.)	Adults (%)		Dead pupae (%)
		Normal	Crimped-wing	
Shipped ¹	2,100	66.5	17.2	16.3
Control	3,000	88.1	1.7	10.3

¹ Shipped 31,500 pupae.

TABLE 6.—*Pupal eclosion following shipment to St. Croix in 1-pint cartons placed in perforated cardboard boxes*

Days in transit	Shipments observed (No.)	Pupae dead on arrival (%)	Emergence of sound adults (%)
1	99	8.1	70.5
2	137	8.1	70.5
3	19	5.6	74.8
¹⁰	254	82.6

¹ Control pupae held at Brownsville, Tex.

tainers had adequate structural strength, but they also required return to the point of shipment.

Shipments in the corrugated boxes resulted in a 10- to 15-percent reduction in healthy moths as compared to insects in the unshipped control (table 6). Mortality in those shipments requiring 3 days' transit was little different than that in shipments reaching the destination in 1 day. However, when shipments were in transit 3 days, many of the moths emerged

in the containers and were lost because they were unable to expand their wings properly.

The uninsulated corrugated box was adopted for shipping pupae from Brownsville to St. Croix and has been adequate for year-round use in southern latitudes, provided that it was properly routed and handled in the mails. However, shipments to areas where the containers and pupae will be subjected to either very low or very high temperatures may warrant the use of insulated shipping containers.

Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.